Heterosporis Update
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Based on a research proposal by

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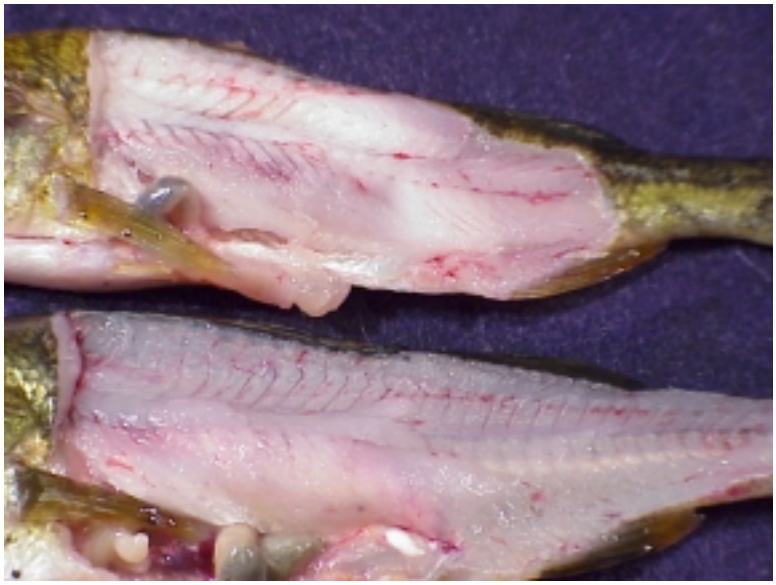
Introduction:
A previously unknown parasite that severely degrades muscle of yellow perch from inland Minnesota and Wisconsin lakes has now been reported from Lake Ontario. Our recent laboratory studies show that yellow perch, walleye, rainbow trout, channel catfish and fathead minnows are extremely susceptible to perch Heterosporis infection and rapidly develop fulminant infections. Having unusually wide host specificity, Heterosporis has great potential to become widely distributed in many important sport and commercial fish populations of the Great Lakes and could be widely translocated by bait fish, stocked fish and other as yet unknown mechanisms.



Perch Heterosporis Infection (Courtesy *Sue Marcquenski*, WI DNR)

Background:
A new microsporidan parasite (Heterosporis sp) was recently found in the

muscle of yellow perch (Perca flavescens) from the Eagle River Chain of Lakes in Vilas County, WI, and is seemingly expanding its range (personal communciation, Sue Marcquenski, Wisconsin Department of Natural Resources).

Fresh infected fillets are milky white in color and granular in texture appearing almost as if they were freezer-burned or already cooked. As much as 80% of the fillet can be affected. Anglers label such heavily infected fillets as inedible and discard them. Prevalence of infection in yellow perch has usually been less than 20% for any given lake. This same parasite has now been confirmed as occurring in Minnesota yellow perch from lakes Winnibigosh, Leech, Vermillion, Mille Lacs, Bear, Moose, Cass and Andrusia, in walleye (Stizostedion vitreum) from Big Sand Lake and northern pike (Esox lucius) from Clitheral Lake (personal communication, Joe Marcino, Minnesota Department of Natural Resources). During summer, 2000 and 2001 this same Heterosporis was confirmed from yellow perch collected in Eastern Lake Ontario and Bay of Quinte (personal communication, Jim Hoyle, Ontario Ministry of Natural Resources). In March, 2002, Heterosporis was also found in the only slimy sculpin (Cottus cognatus) collected from Catfish Lake, Vilas Co., Wisconsin.

This is the first report of Heterosporis in the Western Hemisphere; its identity has been confirmed by Dr. Jiri Lom and Dr. Iva Dykova (Institute of Parasitology, Academy of Sciences of the Czech Republic). Heterosporis has previously been reported from cultured eels in Japan and Taiwan (H. anguillarum Hoshina, 1951), from cultured freshwater angelfish in France (H. finki Schubert, 1969) and cultured ornamental cichlids and loricarid catfish in Germany (H. schuberti Lom, Dykova, Korting and Klinger, 1989). Heterosporis sp has also been reported in commercially reared bettas from Thailand. We are describing the North American Heterosporis as a new species.

Lom and Dykova have successfully infected several Eurasian fish species (Perca fluviatilis, Carassius auratus and Cyprinus carpio) with the North American Heterosporis indicating that it has a wide host specificity. We have recently completed laboratory studies of our own which show that age-0 yellow perch, walleye, rainbow trout, channel catfish and fathead minnows are extremely susceptible to perch Heterosporis and rapidly develop fulminant infections. Largemouth bass and bluegill were much less susceptible to infection and those which did become infected did not develop nearly as extensive muscle destruction as did highly susceptible species. Fish were infected both by "passive" immersion of experimental fish for 12 hours in a suspension of Heterosporis spores and also by being fed small pieces of naturally infected yellow perch flesh. Fish in nature would likely be able to become infected by contacting Heterosporis spores liberated from decaying infected carcasses and also by scavenging dead infected fish. We are currently exposing infected fathead minnows to 20-cm long yellow perch and rainbow trout to ascertain whether adult fish can become infected through predator-prey interactions.

The original source of the Heterosporis found in Wisconsin, Minnesota and Lake Ontario is unknown. Considering how intensively perch are fished in

these regions, one would think that it would have been reported much earlier if it is a native parasite. It is possible that the North American Heterosporis is a native species that previously had not reached sufficient intensities in fish hosts to produce clinical signs. The recent declines of yellow perch stocks in Lake Michigan and elsewhere may stress predator and prey populations to allow emergence of Heterosporis. The sudden emergence of other fish pathogens such as salmonid whirling disease (WD) in wild rainbow trout and cutthroat trout in Montana and Colorado, bacterial kidney disease (BKD) in chinook and coho salmon in Lake Michigan and epizootic epitheliotropic virus disease (EEVD) in Wisconsin lake trout hatcheries are pertinent examples of other recently emergent fish pathogens. It has been suggested that other stressors may have predisposed fish hosts to develop fulminating WD, BKD or EEVD. Alternatively, the emergence of Heterosporis in North America as a conspicuous parasite may be the result of an exotic parasite introduction from an unknown source (for instance, release of infected ornamental fish) that is producing clinical infections in naïve native fish. Accidental or intentional release of bait fish such as fathead minnows might also contribute to rapid dispersal of Heterosporis between drainages.

Dr. Frank Nilsen (Institute of Marine Research, Bergen, Norway) has recently sequenced a significant piece of the rRNA from the North American Heterosporis and has confirmed that it is closely related to H. anguillarum from Asian eels. Unfortunately, the two European species of Heterosporis are not available for comparison. Using the sequences determined by Dr. Nilsen, we have identified suitable primers and developed a polymerase chain reaction (PCR) diagnostic assay. This nested PCR assay provides fish disease biologists with a rapid, sensitive and relatively cheap method for screening fish for overt and subclinical infections of Heterosporis.

We are requesting funding from the Great Lakes Fishery Trust in order to continue investigating the pathogenesis and transmission mechanisms of Heterosporis.

The especially sensitive perch populations within Lake Michigan should be carefully monitored in order that introduction of an additional stressor does not adversely affect these populations further. At present the distribution of Heterosporis in the Great Lakes appears to be confined to a portion of Lake Ontario. We therefore have the opportunity to control a potentially serious parasite of fish and protect fish populations that make up extraordinarily valuable sport and commercial fisheries in the Great Lakes.

The yellow perch commercial fishers in Lake Ontario are very concerned about Heterosporis since infected perch are not marketable. Their immediate questions are:

Q:Is the infection rate likely going to rise (currently about 5% in their harvest)?

There is no way of knowing whether the prevalence will increase in perch;

certainly the fact that this parasite can infect an extraordinarily wide range of hosts (salmonids, cyprinids, ictalurids, and bass in our preliminary lab studies) which are of sport, commercial or bait importance means that they could be widely dispersed by human activities. The role of avian piscivores is also unknown at this time. These are questions that we have proposed to investigate in the GLFT preproposal. While the lakes that we have examined for several years in northern Wisconsin have never exhibited prevalences higher than 20%, we do not yet know if Heterosporis can kill perch and therefore these fish drop out of the seasonal samples. The Wisconsin DNR does not yet seem to think that Heterosporis has effected any significant changes in perch populations at these parasite positive lakes. The DNR continues to monitor several of these lakes.

Q: Is Heterosporis linked to cormorants (which have increased dramatically in the Great Lakes in recent years)?

According to Lom and Dykova (who know more about fish microsporidans than anybody), "spores retain their viability in water at 4oC for at least one year. Fish microsporida are transmitted directly perorally, and the existence of paratenic ("carrier") or intermediate hosts has thus far not been shown. Autoinfection, i.e. hatching of spores in the host in which they were produced, and transovarial transmission have been suggested but also not proven. "

I have not found any mention in the literature of fish microsporidans being transmitted by fish eating birds. But this may simply be that no one has conducted the appropriate studies.

Q: Any insights/comments/opinions would be greatly appreciated.

As with any stressed fish population, presence of a pathogen such as Heterosporis has the potential to lead to an epizootic. Certainly in Lake Michigan yellow perch populations have declined significantly in the last decade, and the introduction of Heterosporis into Lake Michigan would most likely impede recovery of depressed perch stocks.